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An Investigation Of Student Web Activity In A “Flipped” Introductory Physics Class

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Abstract

In the last few years, flipped teaching has become one of the most popular teaching trends being adopted. Yet, there is a lack of data on what students use and find useful while taking these classes. This paper focuses on the use of class web logs, student surveys and class records to analyze student use of the material developed as well as how this use correlates with course results. The course being investigated is taught once a year by the same professor. It is the second course in an introductory physics course sequence for life science majors. The flipped format was adopted gradually in the course starting the Spring 2009 semester. The analysis focuses on the last iteration. The current format of the course was partially driven by student input, and took several years to fully implement. In this case, lecture time is devoted to answer and discuss questions, work on practice problems, and, sometimes, to explore the topics students find interesting. Instead of lectures students complete online multimedia quizzes, embedding both short lecture type recording segments simulations and videos. The quiz format is meant to help students identify the topics they don't understand. Homework is also completed online. It includes both traditional end of the chapter problems and simulation mediated questions. Students also complete pre-laboratory simulation mediated activities. The analysis focused on the analysis of each of the components the students complete online. That data was also correlated to the student performance in various class assignments.

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Keywords: flipped; inverted; reversed; classroom; teaching; web-enhanced; hybrid; blended; active; passive; online; lecture; recordings; video

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1. Introduction

There has been considerable interest in the last few years in what is termed “the flipped or inverted classroom” (Alvarez, 2011; Bergmann, 2012; Bishop, & Verleger, 2013; Herreid, & Schiller, 2013; Rundquist, 2012; Tucker, 2012.). The flipped classroom being a form of blended learning where attempts are made to make class time more of an active environment. This is usually done by combining online delivery of course content with various forms of active engagement activities during lecture time (Bishop, et al., 2013; Hamdan, et al., 2013). The content delivered online varies from professionally prepared video content (Chen, et al., 2010; Sadaghiani, 2011), to compilations of freely available YouTube videos (Riendeau, 2012 ; 2013), and screencast recordings done by the instructors videos (Christensen, W., 2013). The in-class activities also vary (Bishop, et al., 2013; Hamdan, et al., 2013). With the increased interest in this method of teaching, there is interest in research focusing on its overall effectiveness as well as the effectiveness of the various methods and tools used in implementing it. Amazingly, there are several Master Theses (Glynn, 2013; Snowden, 2012; Zownorega, 2013). and at least one PhD theses (Strayer, 2007) that were already completed and focusing on Flipped Teaching. There is also a wealth of articles focusing on both the concept of “Flipped Learning” and on research focusing on “Flipped Learning” (Bishop, et al., 2013; Hamdan, et al., 2013.) In particular, there are a few studies focusing on using this method for teaching physics (Bates, et al., 2012; Deslauriers, et al., 2011; Zownorega, 2013). Yet, the results are mixed and they don’t provide a complete picture on the dynamics of a “Flipped Classroom”. This paper, attempts to add to the knowledge gained by these studies by analyzing students access logs as well as student answers to survey questions in an introductory physics class.

2. Research Design

2.1. Setting

Kennesaw State University (KSU) is a suburban school just northwest of Atlanta, Georgia with a total student enrollment of about 25,000 students. The course is the second of a two semester introductory algebra-based physics course for science majors. 75% of the students who took the course were biology majors, the rest were mainly computer science and exercise science majors. 58% of the students are females. Unfortunately, 85% of the students taken this introductory class have reported themselves as “seniors”. This tardiness is usually due to combination of factors including the limited offerings of course sections as well as a student “fear of physics”. When asked about their interest in taking the course, only 34% indicated any interest. Classes met twice a week for a 75 min lecture and once a week for a 165 min laboratory session. Enrollment in the lecture was capped at 72 and in the lab at 24. Only 65 students have finished all course requirements. The professor taught lecture and one lab section. The other lab sections were taught by a graduate teaching assistant. Two undergraduate Learning Assistants (LAs) helped the professor during lecture (Goertzen et al., 2011).

2.2. Course Details

The course follows of a combination of what is termed as “web-enhanced” format to a “flipped teaching” format. The online tools used for the course were locally developed by the author (Mzoughi, 2000; 2003) and hosted locally at a server on campus. Like for typical course management systems, the tools permit the teacher to manage a dedicated course web page. The course page includes a calendar of classroom activities, links to the course syllabus and to previous test solutions, links to related simulations, as well as links to course related activities. These include forums, pre-lecture quizzes, and an online homework delivery system. Students were instructed on the use of the course web page during the first day of class. Furthermore, videos explaining the use of each of the web components of the course are prominently available at the course web page. Instead of lectures, short concept recordings (CRs) were made available online for all course content. Students were expected to view the CRs before coming to class. The length of the CRs varied from 57 seconds to 29:33 minutes, with a mean of 10:09 minutes (SD=5:50 minutes). A required guiding lecture quiz (GQ) was provided to help students navigate through the CRs. GQ questions were mainly multiple choice. Students were not penalized for multiple submissions. Students were also asked to routinely complete an online form listing the concepts that they have learned and the concepts they still find difficult. The

form is due before lecture, 6 times a semester. These were referred to as “Reflections”. Lecture time was mainly used for problem solving. Students worked on problems written by the authors based on what he perceived as areas they are finding difficult. Students earned grades for completing worksheet questions and for presenting their answers to the rest of the class. Detailed solutions to the worksheets were made available after class. Class time was sometimes used for concept clarifications, demonstrations and discussions. Homework was usually assigned once a week and was completed online. Homework questions are similar to the numerical end of the chapter problems in typical books used for the course. Students were assigned different numerical versions of the same homework problems. They were allowed an unlimited number of trials on each homework problem and were not penalized for making numerous attempts. However, the numeral version of the homework question changes every time the student refreshes the question. Moreover, the students were encouraged to use a dedicated online forum to collaborate on solving the problems. Detailed solutions to the problems were provided automatically right after the deadline. Tests were completed in class during the lecture time. Each test was made up of both conceptual multiple choice questions and show your work questions. A rigorous test correction process was followed after every test allowing students to recuperate some of the grade that they have missed if they demonstrate new learning. The course grade was calculated according to the rubric shown in Table 1. The final course average grade mean is 80.00% (SD 15.66).

Table 1. Course Grade Rubric.

Activity	Percent of the Grade
Homework	17%
Exams	51%
Pre-lecture & lecture quizzes	15%
Laboratory Activities	17%

2.3. Data Collection

Data for this study was collected during the Fall 2013 semester at Kennesaw State University as part of the regular activities of an introductory physics course. The course was taught by Mzoughi, the author of this paper. The study was not designed until the end of the semester. It focuses on the analysis of the course’s archival data as well as an end of semester survey that the students completed for bonus credit. The archival data included student log-in id, ip address, date, time, as well as the link accessed. The data was saved into daily comma separated text files that were combined then analyzed in Microsoft Excel. The survey data came from two sources. One survey was designed by the LAs and administered after the first course exam (1/3 through the semester), and the second was designed by the professor and administered at the end of the semester. The second survey is very long addressing all aspects of the course. Students receive bonus credit for completing it. High performing students usually have no incentive for completing the second survey since they typically don’t need bonus credit. 57 students have completed the first survey but only 42 have completed the end of semester survey.

3. Results and Discussion

When asked about the various elements of the course, like homework, GQs, CRs, Lecture Slides, the student responses closely mirror the distribution shown in Fig 1, for homework. The exception is for reflections; the majority of students did not find them useful. These results are reassuring as they seem to indicate that the students are finding format of the course useful.

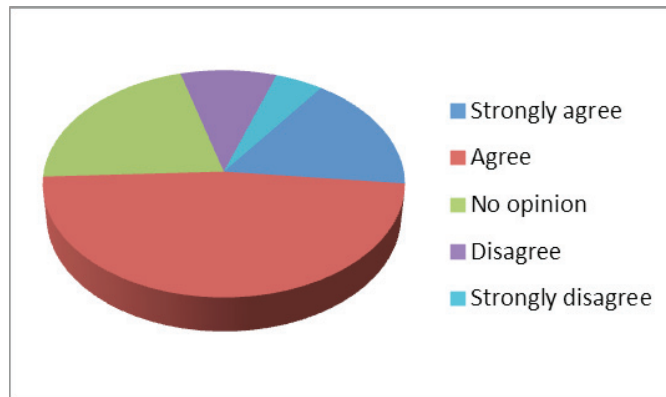


Fig. 1. Student answers when asked “Referring to this course: Completing homework online was helpful in my learning of the material of the course” N = 42

However when asked whether they prefer web-enhanced courses to regular courses, or totally online courses, the level of student interest gradually diminishes. The data is shown in Fig 2 for Web-enhanced courses (A) and totally online courses (B). This indicates that for physics, students fear from the material makes them prefer classes that offer face-to-face interaction with the professor.

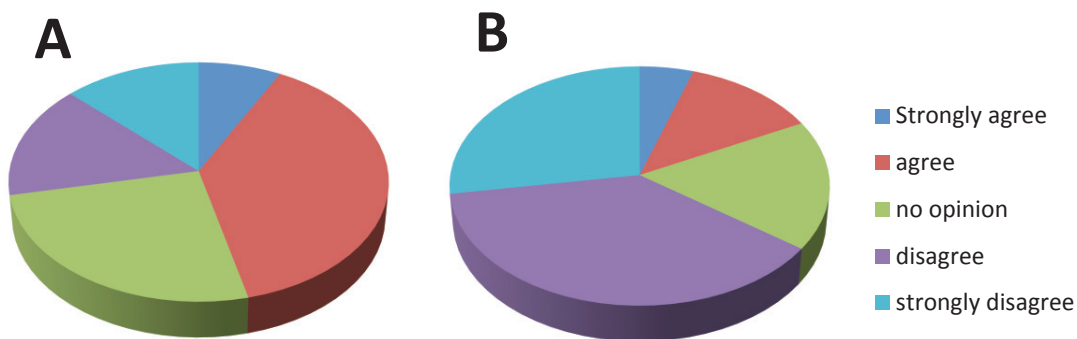


Fig. 2. Student answers when asked “I prefer web-enhanced courses to traditional courses.” (A) and “I prefer totally online courses to traditional courses.” (B) N = 42

When examining the particulars of this “flipped” course, the majority of students seem agreeable to the level of details in the CRs (Fig. 3A), while they really wanted more worked examples covered in CRs (Fig. 3B), and thought the inclass discussions helped their learning (Fig. 3C) however, they still longed for traditional lecturing during class time (Fig. 3D) .

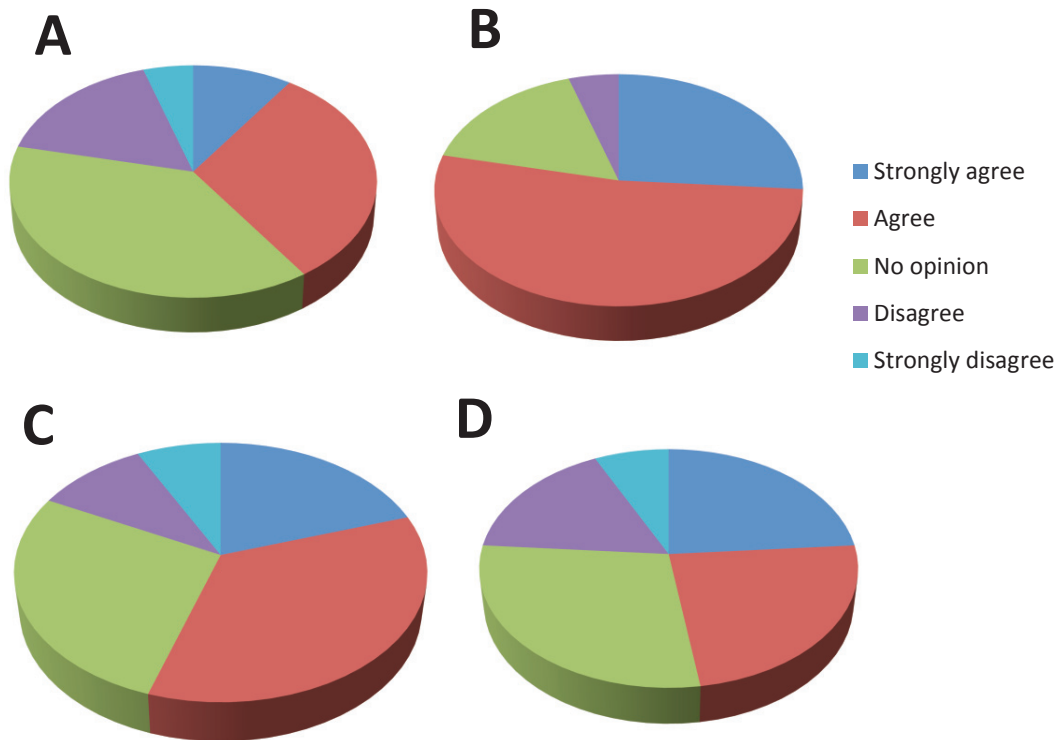


Fig. 3. Student answers when asked "The online recordings were too detailed, I wish they were shorter." (A), "I wish they were more examples worked in the online recordings.." (B), "The inclass discussions were essential in helping me learn the material of the course." (C), and "I wish we had regular lectures instead of inclass discussions." (D) N = 42

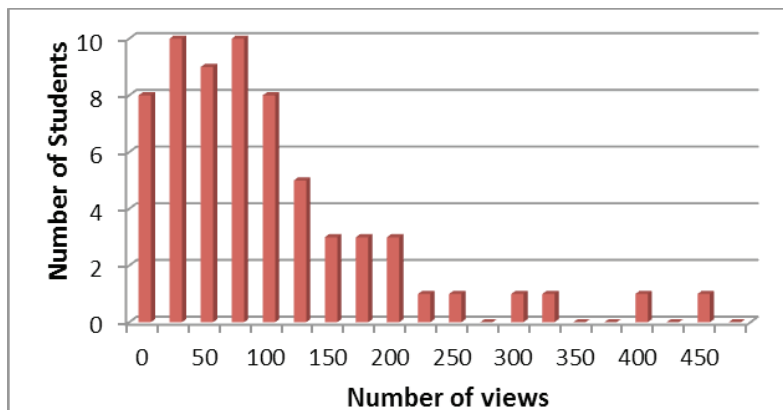


Fig. 4. Distribution of Concept Recording (CR) views

In further questions about the CRs, 29% of the students indicated that the CRs are sufficient for their learning. While 22% indicated that the use of the book was necessary. 34% of the respondents claim to have observed all CRs.; but only 7% claimed to have thoroughly read the book.

Fig 4. shows the distribution of CR views. The mean is 109 views (SD 92), even though the number of available CRs is 182. This indicates that students are selective in what they watch. The correlation coefficient between the final course grade and the number of CR views is 0.256* (significant at 99% level). Even though this correlation is positive, it indicates that other aspects of the course play an important role.

4. Conclusion

The data seems to indicate that the students perceive this flipped course as “effective”. However, different components of the course seem to play equally important roles in helping students learn. More importantly, the data seems to indicate that the students value the interaction with the professor and the LAs. They also long for the traditional lecturing even when they know that they are learning more working on worksheets.

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